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DIVISION;

and

DESCRIPTION OF A RECENT COLLECTION OF DEVONIAN
FOSSILS FROM THE KIMBERLEY DIVISION.

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DISTRIBUTION OF DEVONIAN ROCKS IN THE KIMBERLEY
DIVISION.

A study of collections of fossils from the Kimberley Division shows that Devonian rocks have a wider distribution than has been supposed. Fossils of definitely Devonian age have been found at a number of localities, most of which lie in the area between the Margaret River and Christmas Creek. These localities are:—

- (1) Minyu Gap, Rough Range (long. $135^{\circ} 31'$, lat. $18^{\circ} 25'$). Here the rock is a white crystalline limestone containing such characteristic Devonian forms as *Atrypa aspera*, *A. desquamata*, *A. reticularis*, *Schizophoria striatula*, *Wilsonia cuboides* and *Pugnax pugnus* (see pp. 71-75).
- (2) One mile south of Mt. Pierre Gorge and six miles S.W. of Trig. station J.8 (Mt. Pierre Gorge is not at Mt. Pierre but about twenty-seven miles to the south-east).

Specimens from this locality, Nos. 2523-2528 in the collection of the University Department of Geology, include *Atrypa aspera* and *A. desquamata* (see pp. 71 and 72) in a white or cream-coloured limestone matrix and crinoid stems in a reddish limestone, also a much weathered median section of a cephalopod similar to sections of cephalopods from Mt. Pierre.

- (3) a. Mt. Pierre.

From here Foord (1, p. 149) records *Atrypa reticularis*, *Rhynchonella cuboides*, *R. pugnus*, *Spirifera*, *Orthoceras* and *Goniatites*. These specimens are in the Western Australian Museum. The *Atrypa* specimens (Geol. Surv. No. 10005) are two pieces of white limestone, one of which shows the impression of *Atrypa aspera*, the other contains a specimen of *A. desquamata*. The specimens of *Rhynchonella* (10007) are also in a white limestone matrix. The *Orthoceras* and *goniatites* as well as specimens in the University collection (3028-3030) from the same locality of crinoid stems, *Orthoceras* and various goniatites, are in a reddish limestone matrix.

(3) b Mt. Pierre Creek on track from Fitzroy Crossing to Hall's Creek (near Mt. Pierre).

A large suite of specimens from this locality collected by Professor Clarke and Messrs. Talbot and Blatchford in 1927 is in the collection of the University. The specimens include crinoid stems, a single specimen of a solitary coral, *Orthoceras* and several types of goniatite all in slabs of red limestone.

(4) Minnie Pool (about long. $126^{\circ} 2'$, lat. $18^{\circ} 23' S.$).

R. L. Jack (2, p. 11) records Etheridge's determination of stromatoporoids from the limestones of Minnie Pool which "are therefore either Silurian or Devonian, certainly not Carboniferous." The specimens are described by Etheridge (3, p. 258 and 260) as *Actinostroma subclathratum* and *Stachyodes dendroidea*.

(5) "Opposite Mt. Krauss."

In Hardman's Second Report on the Geology of the Kimberley District 1885, p. 17, he says—"In several places in Rough Range, at Mt. Pierre, at Mt. Krauss, to the south of the Hull Range and in the rocks opposite to that hill* on the south side of the Margaret River, quantities of fossils of Carboniferous age were obtained including Sponges (*Stromatopora*) . . ." The stromatoporoids *Actinostroma clathratum* and *Stromatoporella eifeliensis* were described by Nicholson (1, p. 193) who comments on the presence of such typical examples of these European Middle Devonian species in rocks of the Kimberley District of Western Australia.

The corals *Cyathophyllum virgatum*, *C. depressum*, *Pachypora tumida* and *Aulopora repens* from the same locality are described by Hinde (1, pp. 194-199), who ascribes them doubtfully to the Devonian.

Both the stromatoporoids and several of the corals are also recorded from the Rough Range but the exact locality is unknown.†

(6) Barker Gorge, Napier Range.

A collection from this locality made by H. P. Woodward in 1906 is described by L. Glauert (4, p. 111). The specimens, which are all in a red limestone matrix, include crinoid stems, *Phillipsastraea*, *Pachypora*, *Rhynchonella* cf. *timorensis*, *Proetus* sp. and a portion of a Coccocean fish. The last-named places the age definitely as Devonian. A goniatite is listed but this specimen (F. 332, 6927) is only a broken fragment scarcely recognisable as a cephalopod.

Notes on Basedow's collection contain a reference (3, p. 257) to a white crystalline limestone containing crinoid stems and brachiopods from the Barker Gorge. A later collection was made in 1922 by Mr. J. E. Wells. The specimens (W.A. Museum, Nos.

* Evidently Mt. Krauss.

† It seems that the locality note given by Nicholson, "Rough Range, opposite Mt. Krauss," has been taken to mean one locality, i.e., a spot in the Rough Range opposite Mt. Krauss, but from Hardman's Report it is evident that two of the localities at which fossils were collected were: (a) an unknown locality in the Rough Ranges, (b) the rocks opposite Mt. Krauss on the South side of the Margaret River.

4412-4443) include a stromatoporoid, *Phillipsastraea*, *Atrypa*, *Schizophoria striatula*, *Pugnax pugnus*, *Wilsonia cuboides*, *Spirifer cf. disjunctus*, *Euomphalus*, *Bellerophon* and *Orthoceras*. They are in red and red and white limestone.

(7) Napier Downs, Napier Range (long. $124^{\circ} 35'$, lat. $17^{\circ} 8'$ S.).

The presence of *Stromatoporella* in a white limestone from Napier Downs, according to Etheridge (3, p. 257) "will relegate this limestone to a rather low position in the stratigraphical sequence." The specimen which is described as *S. Kimberleyensis* (p. 259) is very similar in structure to *S. eifeliensis*, characteristic of the Middle Devonian of Europe.

At Mt. Pierre, 3a above, the red limestone containing goniatites is known to underlie the Lower Carboniferous limestone of the Rough Range (5, p. 13, 6, p. 22), thus corresponding to the position of the Devonian limestone of the Barker Gorge, at the base of the limestones forming the Napier Range (4, p. 112) which are also considered to be of Lower Carboniferous age.

The localities (2) and (3) lie on the crests of anticlines, of which that at Mt. Pierre is mentioned by Wade (5, p. 24) and that at Mt. Pierre Gorge is shown on maps by H. W. B. Talbot accompanying reports by Wade (5) and Blatchford (6). A line drawn from Mt. Pierre Gorge along the line of strike passes very close to Minyu Gap, which may therefore lie on the same anticlinal axis.

It seems likely that Devonian rocks may be found emerging from the overlying Carboniferous wherever anticlines of a post-Carboniferous folding have been denuded exposing the lower strata.

AGE OF FOSSILIFEROUS HORIZONS.

Haug, *Traité de Géologie*, p. 711, referring to the Kimberley Division, says that the presence of the Middle Devonian is proved by the stromatoporoids (*Actinostroma clathratum* and *Stromatoporella eifeliensis*), that of the Upper Devonian by *Rhynchonella cuboides* and *Rhynchonella pugnus* associated with indeterminate goniatites.

Benson, who gives a list (7, p. 20) of the Devonian fossils from the Kimberley Division recorded before 1922, states "The accounts of the field occurrence do not indicate that there are two fossiliferous horizons as Haug assumes, and we must therefore consider the Kimberley limestone to be of late Givetian or more probably Frasnian (early Upper Devonian) age."

Although accounts of field occurrence do not indicate that there are two fossiliferous horizons, equally they do not indicate that different horizons are not present. Considering the very small amount of field work that has been done in the Kimberley Division, one can scarcely expect such detailed information.

The constant difference of the matrix of brachiopods from that of cephalopods shown by the large numbers of fossil and rock specimens examined from localities (1)-(3)b seems to indicate that, in the Margaret River-Christmas Creek area at least, there are two bands of limestone distinguishable: (a) the white or cream-coloured *Atrypa* limestone with numerous

brachiopods, (b) the reddish goniatite limestone with *Orthoceras* and crinoid stems but no brachiopods—

- (a) The *Atrypa* limestone contains *Pugnax pugnus* and *Wilsonia cuboides*; therefore, according to Haug, *Traité de Géologie*, p. 711, is Upper Devonian, although these brachiopods may extend down into Middle Devonian.
- (b) The red goniatite limestone, from its position below the Lower Carboniferous limestones of the Napier and Rough Ranges, has long been assumed to be Devonian. The goniatites, which should afford reliable evidence of the age of this limestone, have not been sufficiently studied. Foord (1, p. 102) compared a few fragmentary specimens to *G. rotatorius*, a basal Carboniferous form. Chapman (8, p. 7) tentatively lists several genera as "*Aganides?* sp. nov.; cf. *Gonioclymenia* sp.; *Gastrioceras* sp."

The assumed Devonian age of these goniatite beds is perhaps confirmed by their occurrence at the same localities, viz., Mt. Pierre and Mt. Pierre Gorge, as the *Atrypa* limestone although, indeed, no details of the field relationships between the two are known.

The examination of collections from Barker Gorge does not show a similar twofold division. Here the red limestone, undoubtedly Devonian, contains *Atrypa* and other brachiopods. There is one piece of a slightly different looking red limestone containing *Orthoceras*, but there is no information as to whether or not this comes from the same horizon as the brachiopods. Apart from one very poor specimen, referred to previously, goniatites such as those so plentiful at Mt. Pierre, have not been found. There is a single specimen of a stromatoporoid.

The presence of the Middle Devonian horizon referred to by Haug, cannot be definitely proved owing to the uncertainty of the locality, "opposite Mt. Krauss," from which the two stromatoporoids are recorded. Crusts of what is evidently a stromatoporoid occur on weathered specimens of both the *Atrypa* limestone from Gogo Station and the Goniatite limestone from Mt. Pierre.

The record of stromatoporoids from Prince's Springs, Rough Range (8, p. 6), and of *Stromatoporella kimberleyensis* from Napier Downs (3, p. 259) raises the question of the age of the massive limestones forming the Napier, Oscar, Geikie and Rough Ranges, which have been regarded as Lower Carboniferous. Convincing palaeontological evidence for this is lacking. Although lists of possibly Carboniferous fossils are given by Hardman (9, pp. 10 and 17), there are no specimens of these in the various collections. Amongst those recorded by Wade (5, p. 19) and Blatchford (6, p. 18), *Lonsdaleia* alone indicates a definitely Carboniferous age, yet amongst those recorded from Prince's Springs are three Devonian genera, *Alveolites*, *Pachypona*, and *Stromatoporella*. The only definite indication of the age of these limestones is that they are known to overlie the Devonian limestones of Mt. Pierre and the Barker Gorge apparently without unconformity (5, p. 9).

DEVONIAN FOSSILS FROM THE KIMBERLEY DIVISION.

A white crystalline limestone collected in 1929 by Messrs. T. Blatchford and H. W. B. Talbot from Minyu Gap, Rough Range (long. $135^{\circ} 31'$, lat. $18^{\circ} 25'$), has yielded a small suite of typical Devonian fossils. A few specimens of the same species collected in 1927 from Gogo Bullock Paddock (in which Minyu Gap lies) are in the collection of the University of Western Australia.

Five brachiopod genera are represented, but by far the most abundant in the limestone are specimens of *Atrypa*. These form a very variable series, varying from finely ribbed to coarsely ribbed, and from flattened to deeply convex shells. They fall into three groups according to their ornamentation: (1) Those with coarse ribbing, which may be included in the species *A. aspera*, Schloth; (2) those with fine ribbing, which may be included in the species *A. desquamata*; and (3) an intermediate group linking those of group (1) with those of group (2).

Atrypa aspera, Schloth.

(Pl. VII., figs. 1a-c and 2.)

The coarsely ribbed forms which may be referred to this species resemble forms from Chitral (10, p. 55, pl. III., figs. 4-7) and Burma (11, p. 99, pl. XV., figs. 10 and 10a), rather than those from England (12, p. 57, pl. X., figs. 5-8, and 13, p. 118).

The typical *A. aspera* has the umbo of the ventral valve incurved. This is not shown on the Western Australian specimens. The smaller ones show a small sharp umbo with a subterminal foramen. One or two of the larger ones show the umbo very slightly turned over, but most of the larger specimens are too imperfect in the region of the umbo for this criterion to be determined.

The specimens vary in size from 10mm. to 26mm. in length. In smaller specimens the breadth equals the length, in larger specimens the breadth varies from equal to, to one and a quarter times the length. The young shell is more or less flattened. Larger shells vary from shallow biconvex shapes to those in which the dorsal valve is deeply convex. In some of the flattened forms there is no sinus. A gentle sinus may be present at the anterior margin only. One or two more convex shells have the anterior margin of the ventral valve produced forward. There is no dorsal fold.

As pointed out by Reed, the coarseness of the ribbing varies so that there is great difficulty in placing a line of demarcation between *A. aspera* and *A. reticularis*.

Dimensions—

	I. Largest Specimen.	II. Average-sized Specimens.	III.
Length of ventral valve ...	25mm	21mm.	20mm.
Breadth	33mm.	25mm	20mm.
Thickness	14.5mm	12mm.	10mm.

Specimen numbers:—Geological Survey $\frac{1}{520}$.

Dept. of Geology University 10,033

Atrypa cf. A. aspera.

A single specimen, $\frac{1}{5208}$, with the coarse ornamentation of *A. aspera*, is rather more convex than the average specimens and has a more pronounced sinus at the anterior margin. The lateral margins of the ventral valve are bent ventrally so that the lateral portions of the valve are concave.

This is possibly only an extreme variant of the more convex form of *A. aspera*, but at present the collection does not contain examples linking it to them.

Atrypa desquamata, Sowerby.

(Pl. VII., figs. 3a-c and 4a and b.)

The shells with finer ornamentation agree well with descriptions and figures of *A. desquamata* (12, p. 58, and 11, p. 98). They are circular to transversely oval in shape, the larger shells moderately convex but not as ventricose as *A. reticularis*. A slight flattening of the ventral valve near the margin causes a slight sinus on the larger specimens. The median depression in the dorsal valve mentioned by Whidborne (13, p. 117) is not present in well preserved specimens. In many exfoliated specimens there is a shallow groove running from near the umbo to the anterior. This is due to the uncovering of the depression on the east caused by the medio-longitudinal ridge on the interior of the shell. The umbo of the ventral valve is erect and produced beyond the dorsal valve. This is one of the main points distinguishing the species from *A. reticularis* in which the umbo is incurved. A single specimen, 10032, of the dorsal valve from which the ventral valve has been weathered, shows in the calcite filled interior the bases of the spires, cf. Davidson, fig. 7, pl. XI.

Dimensions—

	I.	II.	III.
Length of ventral valve ...	26mm.	20mm.	14mm.
Length of dorsal valve ...	25mm.	19mm.	12mm.
Breadth	28mm.	21mm.	14mm.
Thickness	15mm.	12mm.	7mm.
Length of hinge (approx.)	13mm.	...	7mm.

The Western Australian specimens like those from Burma described by Reed (11, p. 98, pl. XV., figs. 8-9a) show few of the discriminatory features mentioned by Whidborne (13, p. 115 and 116). They vary in convexity and apart from the sharpness of the umbo which is seldom well preserved, there is little to distinguish the more convex forms of *A. desquamata* from the less convex forms of *A. reticularis*.

A. desquamata has been recorded from the Fanning River district in Queensland (14, p. 66) and from the Murrumbidgee beds of New South Wales.*

The Western Australian specimens seem rather similar to those from Queensland as they agree well with Etheridge's remarks "very much more transverse than those represented by Dr. Davidson on pl. X. of his Devonian monograph but not more so than some of his figures of pl. XI. of the same work. Again the relative convexity of the valves—is very much less than Dr. Davidson's fig. 1b of pl. XI., but is a little more pronounced than the fig. 3a of the same plate."

Specimen numbers—Geological Survey $\frac{1}{5208}$.

Dept. of Geology, University 10032.

* Sussmilch in his Geology of New South Wales lists this on p. 63 as from the Murrumbidgee beds. De Koninck (15 p. 78) records *A. desquamata* but gives no locality.

Atrypa sp. (group 3).

(Pl. VII., fig. 5.)

A number of specimens show ribbing intermediate between that of *A. aspera* and *A. desquamata*. They are all more convex than the average specimens of either of these species and differ from *A. reticularis* in having a sharply pointed umbo.

At present it seems impossible to give these a specific name.

Specimen numbers—Geology Survey $\frac{1}{5210}$.

Atrypa reticularis, Linné.

Three specimens may be placed in this species. Two are elongately oval specimens which compare closely with Davidson's pl. X., Fig. 3 (12). They have slightly finer ornamentation than the specimens grouped as *A. desquamata*, are slightly more convex and have the anterior margin of the ventral valve prolonged, giving a more pronounced sinus at the margin. The umbo is only moderately incurved. The third specimen is large with ornamentation similar to the specimens of *A. desquamata* but a much more swollen dorsal valve. The umbo of the ventral valve is incomplete but the dorsal valve is so swollen in this region that it overshadows the ventral and no deltidium is visible. Even were the tip of the umbo present it could have only projected a fraction above the dorsal valve.

This specimen has a portion of the lamelliform expansion of the shell still attached.

Specimen numbers—Geology Survey $\frac{1}{5211}$.

Dept. of Geology, University 10031.

Atrypa casts.

There are numbers of casts in the collection. On the dorsal surface of five of the smaller ones, $\frac{1}{5213}$, the median depression is very pronounced and bounded on each side by a slight ridge. It is impossible to say whether or not this is a characteristic of a separate species.

Schizophoria striatula, Schloth.

(Pl. VII., fig. 6.)

Although there are only four specimens and in none of these is the area completely exposed, the general features of the specimens are so like those of *S. striatula* that no hesitation is felt in identifying them with this species. They agree with Davidson's description (12, p. 88, pl. XVII., figs. 4-7) in having a transversely oval shell, the dorsal valve much more convex than the ventral, particularly near the umbo, ventral valve with a broad sinus near the front margin, area of the ventral valve wide, that of the dorsal narrow, ornamentation of fine radiating striae. The striae do not appear to "augment in thickness and prominence producing small, hollow, threadlike, tubular spines" but without better specimens it would be impossible to say definitely that these were absent.

Spirifer sp.

(Pl. VII., fig. 7.)

A single specimen of a small *Spirifer* is possibly a new species. It seems likely from its size that it is a young form so that until further specimens are available it would be useless to define a species.

The valves are evenly convex, curved at the anterior margins so that, meeting, these form a blunt edge. Both valves are ornamented with simple strong, rounded ribs, about sixteen on the ventral valve and seventeen on the dorsal. The sinus of the ventral valve is bounded on each side by a strong rib. A single finer rib lies in the sinus. There is no fold on the dorsal valve but its position is occupied by two stronger ribs which will evidently form the fold in a larger shell. The umbo of the ventral valve is high and acute. There is a broad concave area with a wide delthyrium.

Dimensions—

Length of ventral valve	...	...	...	...	10mm.
„ dorsal valve	...	...	...	...	8mm.
Breadth, max. at hinge line	12mm.
Thickness	8mm.
Height of area	3mm.

Specimen Number—

Geology Survey $\frac{1}{5218}$.

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Spines are not shown in figures of specimens from Burma (11, pl. XIII., figs. 19-21), which show a few widely spaced concentric growth lines as do the Western Australian specimens. Figure 21 is very closely comparable to one of these specimens.

Dimensions—

Length	...	...	...	...	18mm.
Breadth	...	...	...	...	21mm.
Thickness	...	...	...	...	13mm.

Specimen Numbers—

Geological Survey $\frac{1}{5214}$.

Wilsonia cuboides, Sowerby.

The collection contains a single specimen and a fragment, both showing the fine ribbing and abrupt parallel-sided sinus of *W. cuboides*. The specimen is very similar to one figured by Davidson (12, p. 65, pl. XIII., fig. 16). It is not well enough preserved to show whether the ribs are split or grooved near the margin.

A specimen of *W. cuboides*, marked Δ 8, Geo. Surv. No. 10008, from the Rough Range is recorded by Foord (1, p. 102). On this specimen grooves are discernible on two of the ribs.

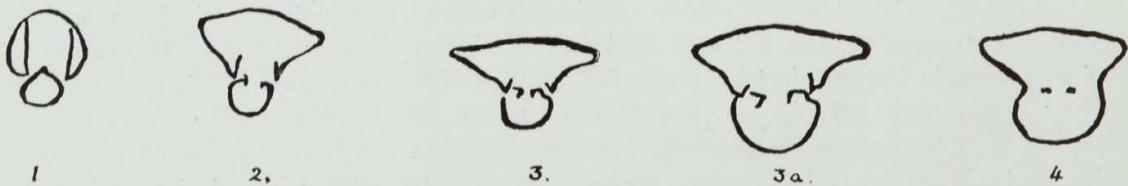
Specimen Number—

Geological Survey $\frac{1}{5216}$.

Pugnax pugnus, Martin.

There are a number of specimens of this species (12, p. 63, and plates 16, p. 97) varying from flattened to tumid shells with a pronounced fold and sinus. Ribs are obsolete on the posterior part of the shell. The generic name was confirmed from the internal structure shown by grinding down the umbo of one of the specimens.

Foord records tumid and flattened varieties of *Rhynchonella pugnus* from Mt. Pierre (1, p. 101). Sections of one of these specimens (Δ 7, Geol. Surv. 10007) were also ground and showed very clearly the dental lamellae of the ventral valve, the divided hinge plate of the dorsal valve and the lack of median septum and cardinal process, all characters of the genus *Pugnax* (17, p. 202).



Series of sections through the umbo of *Pugnax pugnus*, specimen 10007, natural size except 3a, which is 3 slightly enlarged.

Specimen numbers—

Geological Survey $\frac{1}{5217}$
Dept. of Geology, University 10,034.

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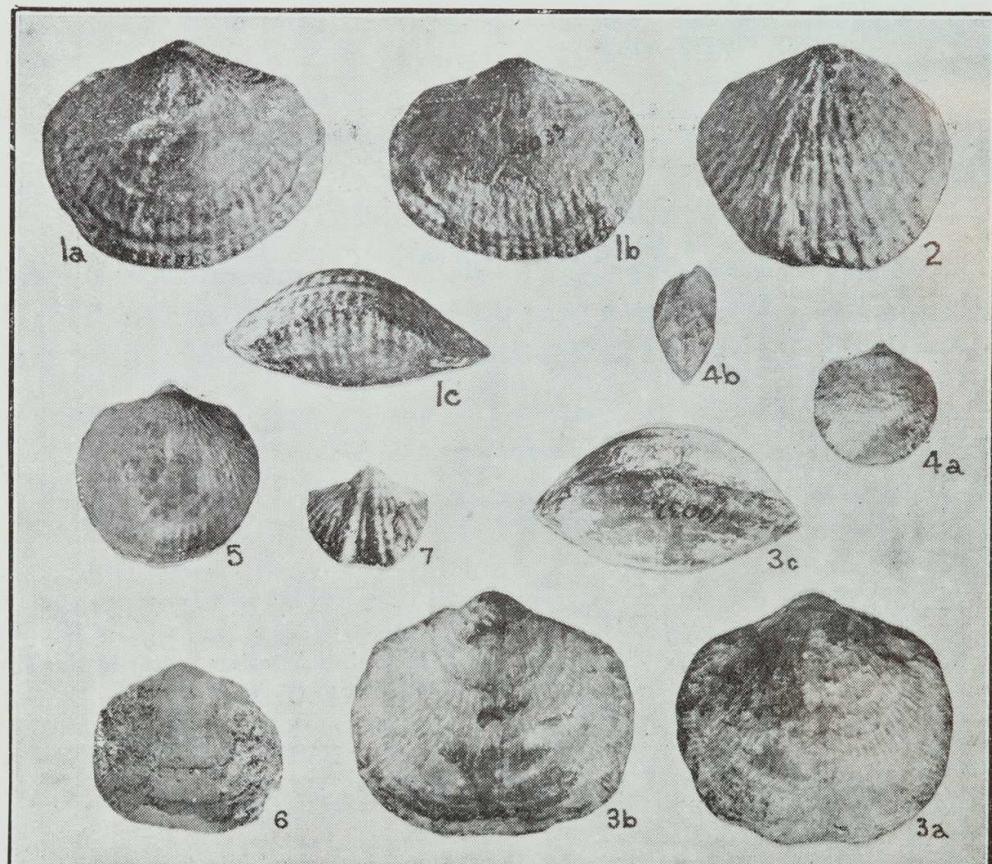


Photo. H. Smith.

Pl. VII.

SKETCH MAP
SHOWING LOCALITIES 1-7 AT WHICH DEVONIAN FOSSILS
HAVE BEEN FOUND

50 0 50 100 150
— Scale of Miles —

